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OBSERVATIONS ON THE SPAWNING OF PHILIPPINE TUNA

By CHARLES B. WADE, Aquatic Biologist

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ABSTRACT

General observations and data concerning the spawning of three species of tuna, *Euthynnus yaito*, *Katsuwonus pelamis*, and *Neothunnus macropterus*, in Philippine waters obtained by biologists of the Philippine Fishery Program of the United States Fish and Wildlife Service, are presented in this publication. The need for a comprehensive knowledge of the life histories of the Pacific tunas has resulted from the increased postwar exploitation of these fishes.

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By CHARLES B. WADE, *Aquatic Biologist*

The study of the life histories of the several commercially important species of tuna in the Pacific Ocean has been greatly accelerated by the postwar expansion of the tuna fishery in that area. One phase of their life histories that has aroused considerable interest and speculation, both scientific and popular, concerns the time and place of spawning. Some research has been done on this in the Mediterranean area, and although incomplete, much has been learned of the early life history of the tuna of that region. In the Pacific, on the other hand, almost nothing was known of their spawning habits until Schaefer and Marr (1948) and Marr (1948) published a series of short papers on the spawning and juvenile forms of the genera *Neothunnus*, *Katsuwonus*, *Euthynnus*, and *Auxis*. They demonstrated, by the collection of juveniles, that these four genera spawn along the west coast of Central America and that the genus *Katsuwonus* also spawns in the northern Marshall Islands.

In the pelagic fish studies of the Philippine Fishery Program [1] of the Fish and Wildlife Service information on all phases of the biology of the Philippine tuna has been sought since October 1947. One part of this operation has been concerned with the accumulation of data on the degree of maturity of the fish caught and the search for juvenile forms. The data were collected on the oceanographic research vessel, *Spencer F. Baird*, from fish caught principally by trolling during the period October 1947 through November 1948.

CLASSIFICATION OF GONADS

Determinations of the degree of maturity were made as the fish were captured, in accordance with the criteria described by Marr (1948). To the stages of gonad development as classified by him, immature, ripening, ripe, spawning, and spent, was added the term "unknown" for those fish in which the gonads were insufficiently developed to determine the sex, or the degree of maturity was not noted for some reason.

Marr (1948) suggested that after the fish spawn for the first time the gonads do not reduce to the small size prevailing before first maturity. The size of the gonads during the so-called "resting stage" between spawning periods is not known. It is impossible at the present time to distinguish externally between gonads ripening for the first time and those that are reduced in size after spawning. At some time during the spawning cycle the two stages could presumably appear identical. There seems to be no doubt that a certain percentage of fish designated as ripening in the present study were in this resting stage.

Although this classification gives a good estimate of the gross changes that occur during the maturation of the gonads, it is not sufficiently precise to evaluate properly the gonad condition in a more comprehensive study. It has been the experience of biologists of the Philippine Fishery Program that the external appearance of the gonads is often deceiving and considerable experience is required to classify these organs correctly.

Many factors contribute to the variations in the external appearance of the gonads that might influence the judgment of the observer. Among these are the size of the specimen, the number of times it had spawned, variations in size and appearance of gonads of seemingly identical specimens, the physical condition of the fish, and there are, no doubt, other factors. The development of a method of ac-

[1] A part of the Philippine Rehabilitation Program authorized by the Philippine Rehabilitation Act of 1946, title 50, App. U. S. Code, Sec. 1789.

curately evaluating the gonad condition will require considerable research. It appears that the ovary, rather than the testes, offers the more satisfactory means of establishing an index to maturity. It may be that after considerable study of the maturation of the eggs in the ovary, a reference point can be located from which small identical samples may be taken. The diameters of the eggs in the sample could then be tabulated and it may be found that combinations of certain percentages of various size classes will provide a formula for determining more accurately the various degrees of maturity.

EUTHYNNUS YAITO (KISHINOUYE)

The field data for this species are presented in tables 1, 2, and 3 and figure 1.

Immature fish were captured only from March through July. The immature females averaged larger than the males, which may have been the result of an inadequate sample. Again, it may indicate that the females grow more rapidly or reach maturity at a greater age and a larger size, than the males, if the growth rate of the two sexes is equal. In addition to the immature fish of which the sex could be determined, specimens were taken of which the sex could not be identified by field methods. The gonads of these fish were elongate, thread-like bodies barely visible in the enveloping membrane and in all cases the weight of the gonads and attached membranes was less than 1 gram.

Ripening fish of both sexes and in all stages of ripening were captured throughout the year. This suggests that spawning is not confined to any particular period. Also, based on the size range of ripening and ripe specimens in the collections, it is evident that *E. yaito* begins to ripen at a smaller size than this sample of ripening fish would indicate.

The difficulty of distinguishing ripe from spent males has, undoubtedly, introduced some degree of error in the number of ripe males reported. The tendency has been to classify males as ripe rather than spent. On the other hand, no error of this nature should occur with the females. Considerable range in the size of ripe gonads was noted not only throughout the size range, but among individuals of similar size.

Spawning and spent fish were taken throughout the period of operation. No running-ripe females were seen although specimens were secured in which the eggs were lying free in the posterior part of the ovary. Spawning males were common, however, often extruding milt on the deck when brought aboard ship.

There is only one specific reference to the spawning of *E. yaito* in the literature. Kishinouye (1923) stated that spawning takes place in Taiwan (Formosa) about May. This observation was based on a single 115 mm. specimen collected from that area during the latter part of August. Schaefer and Marr (1948) collected a running-ripe female of

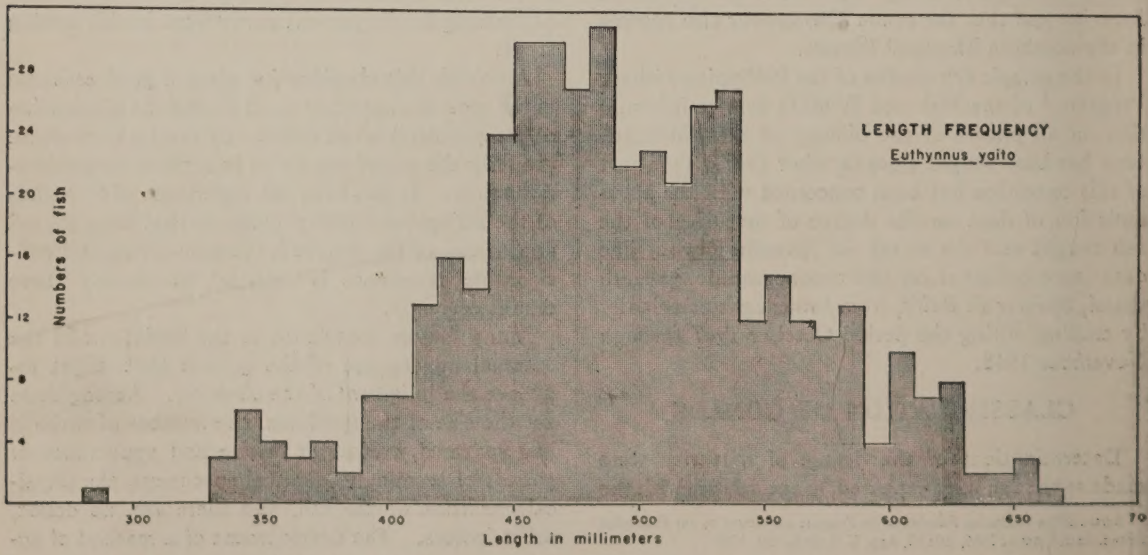

FIGURE 1.—Length-frequency distribution of *Euthynnus yaito* taken in Philippine waters from October 1947 through November 1948.

a closely related species, *Euthynnus lineatus*, off the west coast of Central America in April.

The presence of fish in all stages of sexual development during the entire year in Philippine waters seems indicative of year-round spawning in that area. Although its is certain that spawning does occur throughout the year, the sample is not sufficiently large to determine possible seasonal variations in intensity during that time.

KATSUWONUS PELAMIS (LINNAEUS)

The data for *Katsuwonus pelamis* are presented in tables 4, 5, and 6 and figure 2.

Only an occasional immature fish was taken during the entire period of operations. The poor representation of small, immature fish of all species in the collections can be explained partly by the fact that the trolling gear was designed primarily for larger fish and, consequently, smaller specimens could not readily take the lure.

TABLE 1.—*Monthly summary of all specimens of* Euthynnus yaito *taken by the* Spencer F. Baird, *October 1947–November 1948*

Month	Immature	Ripening	Ripe	Spawning	Spent	Unknown	Total
ALL FISH							
October							
November			1				1
December		7	2	15		2	26
January		1	10	27	1		39
February		26	23	9	37	14	109
March			5	6	1	2	14
April	5		6	10	17	1	39
May	10	14	11	34	16	4	89
June	2	1	14	2	4		23
July	2	1	5	6	4		18
August			1				1
September							
October		1	1	5	7		14
November		46	9	23	8	1	87
Total	19	97	88	137	95	24	460
MALES							
October							
November							
December		3	1	15			19
January		1	4	16			21
February		25	23	6		1	55
March			1	3			4
April	3		3	9			15
May		4	8	32		1	45
June		1	9	2			12
July	2		1	6			9
August			1				1
September							
October				5	4		9
November		18	5	23	3		49
Total	5	52	56	117	7	2	239
FEMALES							
October							
November			1				1
December		4	1			2	7
January			6	13	1		20
February		1		3	37	1	42
March			4	3	1	1	9
April	5		3	1	17		26
May	7	10	3	2	16		38
June	2		5		4		11
July		1	4		4		9
August							
September							
October		1	1		3		5
November		28	4		5		37
Total	14	45	32	22	88	4	205

TABLE 2.—*Length-frequency and degree of maturity of troll-caught* Euthynnus yaito *from Philippine waters, taken by the* Spencer F. Baird, *October 1947–November 1948*

Length in millimeters	Immature			Ripening			Ripe			Spawning			Spent			Unknown [1]		
	All	Male	Female	All	Male	Female	All	Male	Female	All	Male	Female	All	Male	Female	All	Male	Female
280–289																1		
290–299																		
300–309																		
310–319																		
320–329																		
330–339	2		2													1		
340–349	4	1	3				1	1								2		
350–359	2	1	1													3		
360–369				2		2										1		
370–379	1		1	2	1	1				1	1							
380–389	3	3		2	1	1												
390–399	1		1	1		1												
400–409	1		1	2		2	1		1	2	2		1		1			
410–419	1		1	4		4	1		1							1		
420–429	1		1	5	2	3	4	3	1	1	1					2		
430–439				1	1		4	2	2	1	1		1		1			
440–449	1		1	1		1	4	3	2	3	3		4		4	2		
450–459	1		1	1		1	6	1	5	5	4	1	4		4	1		
460–469	1		1	12	6	6	1		1	2	2		6		6			
470–479				11	8	3	2	2		12	10	2	2		2	2		1
480–489				11	4	7	3	2	1	9	8	1	8		8			
490–499				10	7	3	6	4	2	8	7	1	1		1	2	2	

See footnote at end of table.

TABLE 2.—*Length-frequency and degree of maturity of troll-caught* Euthynnus yaito *from Philippine waters, taken by the* Spencer F. Baird, *October 1947–November 1948*—Continued

Length in millimeters	Immature			Ripening			Ripe			Spawning			Spent			Unknown [1]		
	All	Male	Female	All	Male	Female	All	Male	Female	All	Male	Female	All	Male	Female	All	Male	Female
500–509				5	3	2	10	7	3	6	5	1	11		11			
510–519				4	3	1	5	4	1	6	6		7	2	5	1		1
520–529				3	1	2	3	3		8	5	3	9	1	8			
530–539				3	1	2	4	4		4	3	1	9		9	1	1	
540–549				5	4	1	2	1	1	13	11	2	6		6			
550–559				4	3	1	7	4	3	5	5		10	2	8			
560–569				2	2		4	2	2	5	4	1	5	2	3	1	1	
570–579				2	1	1	5	3	2	5	4	1	2		2	1		
580–589							4	2	2	6	6		3		3	1		
590–599				2	2		1		1	6	5	1	2		2			
600–609							3	1	2	6	3	3	2		2			
610–619										5	5							
620–629							1	1		5	3	2	1		1			
630–639				1	1		2	2		3	2	1	1		1	1		
640–649							1	1		6	5	1						
650–659							1	1		1	1							
660–669							1	1		1	1							
670–679				1	1					2	2							
680–689							1	1										
Total	19	5	14	97	52	45	88	56	32	137	115	22	95	7	88	24	4	2

[1] Includes those specimens in which the sex and gonad condition were not known or one or other was unknown.

TABLE 3.—*Locality, length, sex, degree of maturity, and gonad weight of* Euthynnus yaito *taken by the* Spencer F. Baird *in Philippine waters, October 1947–November 1948*

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1947					
Nov. 11	Zamboanga	580	Female	Ripe	135.0
Dec. 5	Sulu Archipelago	585	do	do	141.0
Dec. 14	Pilas Island, Sulu Archipelago.	621	do	Ripening	123.5
14	do	557	do	do	111.3
14	do	625	Male	Spawning	103.5
14	do	582	do	Ripe	37.0
14	do	533	do	Ripening	73.1
14	do	529	do	do	52.8
14	do	557	do	do	91.2
14	do	596	do	Spawning	84.4
Dec. 15	Zamboanga	584	do	do	130.0
15	do	607	do	do	140.0
15	do	570	do	do	120.0
15	do	535	do	do	98.0
15	do	566	Female	do	99.5
15	do	545	Male	Spawning	162.5
15	do	491	do	do	73.0
15	do	499	Female	do	69.0
15	do	471	Male	Spawning	49.0
15	do	488	Female	Ripening	47.0
15	do	470	Male	Spawning	43.0
15	do	479	do	do	74.0
15	do	474	do	do	46.5
15	do	455	do	do	39.0
15	do	466	do	do	63.0
Dec. 16	do	592	do	do	86.0
16	do	462	Female	Ripening	39.0
1948					
Jan. 7	South Sulu Sea	594	Male	Spawning	133.6
7	do	603	Female	do	82.4
7	do	556	Male	do	53.2
7	do	618	do	do	129.0
7	do	578	do	do	72.4
7	do	593	Female	do	162.5
7	do	613	Male	do	81.0
7	do	545	do	do	70.0
7	do	620	do	do	102.5
7	do	637	do	Ripening	97.5
7	do	656	do	Spawning	178.5
7	do	566	Female	Spent	62.3
7	do	601	do	Ripe	154.5
Jan. 12	do	512	do	do	70.0

[1] Preserved in the round.

TABLE 3.—*Locality, length, sex, degree of maturity, and gonad weight of* Euthynnus yaito *taken by the* Spencer F. Baird *in Philippine waters, October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
Jan. 14	Pilas Island, Sulu Archipelago.	600	Female	Spawning	140.0
14	do	526	Male	do	104.0
14	do	611	do	do	113.5
14	do	605	Female	do	177.5
14	do	481	do	do	63.0
14	do	550	Male	Ripe	101.0
14	do	477	Female	Spawning	67.7
14	do	634	Male	Ripe	133.7
14	do	545	do	Spawning	98.7
14	do	571	Female	do	136.0
14	do	540	do	do	74.6
14	do	620	do	do	133.5
14	do	591	Male	do	92.7
14	do	601	Female	do	126.0
14	do	497	Male	do	53.3
14	do	430	Female	Ripe	41.0
14	do	562	do	do	59.5
14	do	457	do	do	58.5
14	do	454	Male	Spawning	79.1
14	do	484	do	do	61.6
14	do	496	do	do	55.0
14	do	485	Female	Ripe	72.0
14	do	523	Male	do	64.0
14	do	542	do	do	75.0
14	do	522	Female	Spawning	75.0
14	do	540	do	do	113.5
14	do	560	do	do	98.0
Feb. 19	Port Santa Maria, Zamboanga Peninsula.	550	Male	Ripe	37.5
19	do	480	Female	Spent	19.4
19	do	622	Male	Ripe	188.6
19	do	530	Female		37.7
19	do	645	(1)		
19	do	576	(1)		
19	do	476	(1)		
19	do	424	(1)		
19	do	422	(1)		
19	do	582	(1)		
19	do	446	(1)		
19	do	443	(1)		
19	do	687	Male	Ripe	150.0
19	do	565	do	Spawning	43.0

TABLE 3.—*Locality, length, sex, degree of maturity, and gonad weight of* Euthynnus yaito *taken by the* Spencer F. Baird *in Philippine waters, October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
Feb. 19	Port Santa Maria, Zamboanga Peninsula.	558	Female	Spent	37.6
19	do	560	do	do	37.5
19	do	510	Male	Spawning	34.5
19	do	503	do	Ripening	165.0
19	do	535	Female	Spent	63.1
19	do	540	Male	Ripening	27.5
19	do	510	Female	Spent	33.8
19	do	562	Male	Ripening	33.0
19	do	642	do	Ripe	110.3
19	do	556	do	do	58.1
19	do	592	do	Ripening	44.2
19	do	651	do	Ripe	90.5
19	do	575	Female	Spent	54.4
19	do	600	do	do	69.1
19	do	558	Male	Spawning	67.0
19	do	564	do	Ripening	26.0
19	do	673	do	do	221.6
19	do	555	do	Spawning	8.3
19	do	520	Female	Spent	48.3
19	do	510	do	do	44.9
19	do	560	Male	Ripe	69.7
19	do	508	Female	Spent	29.8
19	do	570	Male	Ripening	28.2
19	do	560	do	do	21.9
19	do	462	do	do	15.6
19	do	540	do	do	33.7
19	do	587	Female	Spent	42.6
19	do	494	Male	Ripening	28.2
19	do	509	Female	Spent	48.8
19	do	490	do	do	18.6
19	do	472	Male	Ripe	25.2
19	do	516	Female	Spent	25.3
19	do	466	do	Ripening	14.7
19	do	562	do	Spent	35.2
19	do	596	do	do	51.5
19	do	668	Male	Ripe	125.5
19	do	558	Female	Spent	41.4
19	do	530	do	do	48.3
19	do	530	do	do	34.7
19	do	532	Male	Ripe	26.1
19	do	595	do	Ripening	22.1
19	do	520	do	Ripe	32.3
19	do	550	do	do	43.5
19	do	515	do	do	27.8
19	do	509	do	do	34.3
19	do	603	Female	Spent	51.7
19	do	515	do	do	28.5
19	do	501	Male	Ripening	18.5
19	do	471	Female	Spawning	14.5
19	do	573	Male	Ripe	95.9
19	do	554	do	Ripening	51.7
19	do	559	do	do	51.6
19	do	460	do	do	7.6
19	do	484	Female	Spent	24.8
19	do	500	do	do	29.3
19	do	463	Male	Ripening	10.4
19	do	470	Female	Spent	17.9
19	do	466	do	do	11.4
19	do	475	Male	Ripening	8.3
19	do	548	do	do	36.8
19	do	533	Female	Spent	23.4
19	do	518	Male	Ripening	13.4
19	do	526	Female	Spent	26.8
19	do	510	Male	Ripening	18.5
19	do	498	do	Ripe	21.2
19	do	534	Female	Spawning	44.9
19	do	472	Male	Ripening	7.6
19	do	514	do	do	13.1
19	do	523	Female	Spent	28.4
19	do	467	do	do	16.7
19	do	477	Male		12.5
19	do	493	do	Ripe	29.3
19	do	502	do	do	22.7
19	do	522	Female	Spent	38.5
19	do	507	Male	Ripe	17.9
19	do	483	do	do	9.9
19	do	477	do	do	11.1
19	do	501	Female	Spent	21.7
19	do	503	Male	Ripe	15.9
19	do	480	Female	Spent	17.3
19	do	485	Male	Ripe	22.1
19	do	460	do	Ripening	6.5
19	do	510	do	Spawning	74.1
19	do	527	Female	Spent	28.3

[3] Gonads insufficiently developed to determine the sex.

TABLE 3.—*Locality, length, sex, degree of maturity, and gonad weight of* Euthynnus yaito *taken by the* Spencer F. Baird *in Philippine waters, October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
Feb. 19	Port Santa Maria, Zamboanga Peninsula.	494	Female	Spawning	44.6
19	do	458	do	Spent	13.6
19	do	478	Male	Ripening	19.2
19	do	519	Female	Spent	32.2
19	do	488	do	do	23.1
19	do	508	do	do	23.5
Feb. 21	Zamboanga	638	Male	Spawning	223.5
Feb. 23	Margosatubig, Moro Gulf	339	[3]	Immature	
23	do	355	[3]	do	
23	do	345	[3]	do	
23	do	355	[3]	do	
Mar. 2	Bangka Passage, Celebes	283	[3]	do	1
2	do	283	[3]	Ripe	28.1
2	do	571	Female	do	161.2
2	do	521	do	Spawning	80.9
2	do	542	do	Spent	56.3
2	do	520	Male	Spawning	56.9
2	do	498	Female	do	48.9
2	do	500	do	Spawning	69.3
Mar. 13	West coast of Panay	575	Male	do	159.2
13	do	553	Female	Ripe	185.7
13	do	508	do	do	220.0
13	do	505	do	do	119.0
13	do	406	Male	Spawning	38.7
13	do	455	Female	do	43.8
Apr. 6	North Sulu Sea	447	Male	do	39.8
6	do	440	Female	Spent	24.0
6	do	473	Male	Spawning	61.7
6	do	406	Female	Spent	16.0
6	do	443	do	do	21.7
6	do	443	do	do	51.5
6	do	448	Male	Ripe	36.8
6	do	426	Female	Immature	6.8
Apr. 8	Sulu Archipelago	600	Male	Ripe	56.9
8	do	543	Female	Spent	50.4
8	do	485	do	do	24.9
8	do	450	do	Immature	8.9
8	do	412	do	do	3.4
8	do	395	do	do	1.4
8	do	632	do	Spawning	66.4
8	do	530	do	Spent	42.4
8	do	472	do	do	24.4
8	do	490	Male	Ripe	66.3
8	do	540	Female	Spent	66.2
8	do	509	do	do	30.4
8	do	663	Male	Spawning	99.9
8	do	500	Female	Spent	31.1
8	do	553	Male	Spawning	70.3
8	do	542	Female	Spent	46.5
8	do	525	Male	Spawning	38.1
8	do	419	[3]	Immature	4.6
8	do	561	Female	Spent	38.2
8	do	592	do	Ripe	116.1
8	do	648	Male	Spawning	123.6
8	do	545	Female	Spent	
8	do	585	do	do	66.0
8	do	375	do	Immature	1.3
Apr. 17	do	484	do	Spent	33.8
17	do	484	Male	Spawning	10.5
17	do	504	Female	Ripe	44.9
17	do	593	do	Spent	94.0
Apr. 18	do	567	Male	Spawning	46.1
18	do	485	do	do	29.0
Apr. 21	West Zamboanga Peninsula.	543	Female	Ripe	83.6
May 5	North Sulu Sea	511	Male	Spawning	12.0
5	do	532	Female	Ripening	18.2
5	do	495	Male	Spawning	10.8
5	do	452	Female	Ripening	10.2
5	do	475	Male	do	6.5
5	do	499	do	do	6.5
5	do	498	Female	do	20.1
5	do	494	do	do	17.0
May 7	Pilas Island, Sulu Archipelago.	574	Male	Ripe	23.8
7	do	515	Female	Spawning	41.5
7	do	556	do	Ripe	92.0
7	do	359	[3]	Immature	
7	do	548	Male	Spawning	85.1
7	do	527	do	do	25.0
7	do	505	Female	Spent	14.7
7	do	514	Male	Spawning	22.1

TABLE 3.—*Locality, length, sex, degree of maturity, and gonad weight of* Euthynnus yaito *taken by the* Spencer F. Baird *in Philippine waters, October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
May 7	Pilas Island, Sulu Archipelago.	547	Male	Spawning	39.1
7	do	608	do	do	100.6
7	do	570	do	Ripe	71.8
7	do	591	do	Spawning	41.4
7	do	540	do	do	44.5
7	do	500	Female	Spent	27.5
7	do	511	do	Ripening	20.8
7	do	400	do	Immature	3.1
7	do	521	do	Ripening	22.5
7	do	539	Male	Ripe	29.3
7	do	548	do	Spawning	53.5
May 8	do	547	Female	Ripening	42.0
8	do	454	Male	Spawning	3.4
8	do	501	Female	Ripening	44.8
8	do	549	Male	Spawning	54.5
8	do	644	Female	do	96.5
8	do	539	Male	do	25.9
8	do	500	do	do	32.5
8	do	527	Female	Spent	35.7
8	do	530	do	do	41.0
8	do	525	do	do	39.0
8	do	536	do	do	36.9
8	do	532	do	do	34.5
8	do	531	do	do	26.2
8	do	521	Male	Spawning	21.9
8	do	620	Female	Spent	86.5
8	do	498	Male	Ripening	11.5
8	do	492	do	Spawning	22.0
8	do	498	Female	Ripening	18.2
8	do	361	(?)	Immature	
8	do	345	(?)	do	
8	do	459	Male	Spawning	15.5
8	do	566	do	do	42.6
8	do	554	do	do	21.9
8	do	578	Female	Ripening	15.5
8	do	513	Male	Immature	3.3
May 10	Moro Gulf, Mindanao	515	do	Ripe	58.1
10	do	531	do	do	59.8
May 12	do	476	do	Ripening	7.3
12	do	383	do	Immature	2.0
12	do	343	Female	do	4.2
12	do	344	Male	do	2.5
May 15	Davao Gulf, Mindanao.	348	Female	do	3.8
15	do	343	do	do	2.2
15	do	356	do	do	7.2
15	do	358	Male	do	2.1
15	do	331	Female	do	4.8
15	do	334	do	do	3.4
15	do	435	do	Spent	13.1
May 17	Sulu Archipelago	564	do	Ripe	51.5
17	do	648	Male	Spawning	84.5
17	do	677	do	do	65.8
17	do	626	Female	Spent	58.9
17	do	636	Male	Ripe	35.0
17	do	637	Female	Spent	51.5
17	do	605	Male	Spawning	71.0
17	do	641	do	do	69.5
17	do	566	do	do	106.0
17	do	642	do	do	97.5
17	do	612	do	do	65.5
17	do	549	do	do	54.0
17	do	587	do	do	52.0
17	do	583	do	do	732.0
17	do	516	do	do	45.0
17	do	532	do	Ripe	19.9
17	do	499	do	Spawning	31.0
17	do	634	do	do	35.5
17	do	604	Female	Ripe	143.4
17	do	554	do	Spent	27.8
May 18	do	556	do	do	51.0
18	do	568	Male	Ripe	46.2
18	do	542	Female	Spent	37.5
18	do	557	do	do	35.5
June 16	North Sulu Sea	485	do	do	12.7
16	do	463	do	do	15.0
16	do	461	do	Immature	3.2
16	do	442	do	do	1.2
16	do	515	Male	Spawning	10.6
16	do	467	Female	Spent	15.6
16	do	479	Male	Spawning	15.8
16	do	458	Female	Spent	13.6
June 27	do	512	Male	Ripe	37.5
27	do	580	do	do	85.5
27	do	508	do	do	35.8
27	do	498	do	do	35.2

TABLE 3.—*Locality, length, sex, degree of maturity, and gonad weight of* Euthynnus yaito *taken by the* Spencer F. Baird *in Philippine waters, October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
June 29	Busuanga Islands, China Sea.	448	Male	Ripe	21.0
29	do	431	Female	do	14.0
29	do	436	Male	do	9.7
29	do	425	do	do	6.2
29	do	491	Female	do	70.0
29	do	428	Male	do	21.0
29	do	492	Female	do	42.4
29	do	401	do	do	24.5
29	do	362	Male	Ripening	2.0
29	do	454	Female	Ripe	18.0
29	do	450	Male	do	18.3
July 11	South Sulu Sea	388	do	Immature	2.0
11	do	486	do	Spawning	27.3
July 12	Southwest Sulu Sea	385	do	Immature	2.0
12	do	484	do	Spawning	37.0
July 14	Balabac Island, Sulu Sea.	582	Female	Spent	89.7
14	do	555	do	do	104.7
14	do	548	Male	Spawning	75.5
14	do	549	do	do	82.5
14	do	550	Female	Spent	92.5
14	do	450	do	Ripe	45.0
14	do	406	do	Ripening	8.0
14	do	565	do	Ripe	87.0
14	do	611	Male	Spawning	178.0
14	do	546	do	do	48.5
14	do	571	Female	Spent	25.9
14	do	508	Male	Ripe	41.3
14	do	458	Female	do	63.5
14	do	457	do	do	50.0
Aug. 9	Sibuguey Bay, Moro Gulf.	348	Male	do	18.0
Oct. 31	North Palawan, China Sea.	467	do	Spawning	9.0
31	do	432	do	do	11.0
31	do	524	Female	Spent	25.0
31	do	425	Male	Spawning	9.0
31	do	412	Female	Ripening	9.0
31	do	507	Male	Spent	15.0
31	do	448	Female	do	12.0
31	do	473	Male	Spawning	8.0
31	do	455	Female	Spent	25.0
31	do	550	Male	do	10.0
31	do	503	do	Spawning	10.0
31	do	550	do	Spent	14.0
31	do	463	Female	Ripe	50.0
31	do	511	Male	Spent	5.0
Nov. 2	do	496	do	Ripening	5.0
Nov. 4	do	550	do	Spent	6.0
4	do	565	do	do	10.0
4	do	465	Female	do	20.0
4	do	464	do	do	26.0
4	do	450	do	do	10.0
Nov. 5	Northeast Palawan	428	Male	Ripe	8.0
Nov. 6	North Palawan	485	do	Ripening	3.0
6	do	481	Female	do	6.0
6	do	490	Male	do	3.0
6	do	482	do	do	6.0
6	do	487	Female	do	18.0
Nov. 7	Northeast Palawan	478	do	do	13.0
7	do	482	do	do	14.0
7	do	473	Male	do	7.0
7	do	481	Female	do	16.0
7	do	470	Male	do	7.0
7	do	495	do	do	7.0
7	do	475	do	do	4.0
7	do	402	Female	do	8.0
7	do	380	Male	do	4.0
7	do	420	do	do	4.0
Nov. 8	West Sulu Sea	420	Female	do	9.0
8	do	420	do	do	9.0
8	do	430	Male	do	2.0
8	do	414	Female	do	8.0
8	do	410	(?)	Immature	
Nov. 9	Southwest Sulu Sea	416	Female	Ripening	6.0
9	do	428	do	do	10.0
9	do	477	Male	Spawning	16.0
9	do	521	do	do	12.0
9	do	522	Female	Ripening	24.0
9	do	508	do	Ripe	22.0
9	do	441	Male	Spawning	10.0
Nov. 10	do	520	do	Ripe	10.0
10	do	468	Female	Ripening	16.0
Nov. 11	do	442	do	do	8.0
11	do	475	do	do	6.0
11	do	535	do	do	20.0

TABLE 3.—*Locality, length, sex, degree of maturity, and gonad weight of* Euthynnus yaito *taken by the* Spencer F. Baird *in Philippine waters, October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
Nov. 11	Southwest Sulu Sea	508	Female	Ripening	18.0
11	do	518	Male	Ripe	6.0
11	do	480	do	Ripening	4.0
11	do	465	do	do	4.0
11	do	506	do	do	8.0
11	do	462	Female	do	14.0
11	do	480	Male	Spawning	12.0
11	do	503	do	do	8.0
11	do	472	Female	Ripening	14.0
11	do	485	do	do	12.0
Nov. 12	do	490	Male	do	4.0
12	do	430	do	Ripe	6.0
12	do	575	do	Spawning	48.0
12	do	585	do	do	50.0
12	do	585	do	do	48.0
12	do	545	Female	Spent	44.0
Nov. 13	West Sulu Sea	385	do	Ripening	10.0
13	do	391	do	do	10.0
13	do	500	Male	Spawning	22.0
13	do	505	do	do	17.0
13	do	490	do	do	23.0
13	do	525	do	Spent	9.0
13	do	482	Female	do	19.0
13	do	485	Male	Spawning	12.0
13	do	487	do	do	12.0
13	do	470	do	do	17.0
13	do	475	do	do	18.0
13	do	472	do	do	12.0
Nov. 16	South Sulu Sea	420	do	Ripening	5.0
16	do	460	do	do	12.0
16	do	410	Female	do	8.0
16	do	460	do	do	14.0
16	do	480	Male	do	11.0
Nov. 17	do	445	Female	Ripe	40.0
17	do	440	Male	do	30.0
17	do	410	Female	do	30.0
17	do	670	Male	Spawning	145.0
17	do	649	do	do	78.0
17	do	625	do	do	90.0
17	do	428	Female	Ripe	40.0
17	do	467	do	Ripening	10.0
Nov. 22	North Sulu Sea	405	Male	Spawning	20.0
22	do	375	Female	Ripening	4.0
22	do	442	Male	Spawning	20.0
22	do	400	do	do	10.0
Nov. 23	West of Mindoro	365	Female	Ripening	6.0
23	do	360	do	do	8.0
23	do	370	Male	Spawning	8.0

Although the sample of ripening fish is too small to permit definite conclusions, there are indications of the possible trend in the maturation of this species. Those fish caught during the first half of the year appear to have ripening gonads more fully developed than those taken during the latter half. This suggests that spawning occurs mainly during the late spring and summer months. Ripe *K. pelamis* were taken throughout the islands during the entire year, but in the greatest abundance in April, May, June, and July. The larger number of ripe fish taken during this period is probably indicative of a period of more intensive spawning.

Spawning and spent fish were taken from March through July and scattered specimens during the remainder of the year. The majority of spawning *K. pelamis* were males, but the larger percentage of spent fish were females. From the information available the reversal of sex dominance in spawning and spent fish cannot be explained. The lack of spent males may be partly explained as resulting from misidentification of the stage of maturity. At the present time there is no way to determine accurately the differences between males approaching spawning and those past the peak of spawning. The larger percentage of spawning males caught probably can be explained in that the aggressiveness of the male during spawning makes him more prone to strike at a lure.

The only reference available on the spawning of this species in the western Pacific (Kishinouye 1923) indicates that in Japan *K. pelamis* spawns from May to August. This period coincides with what is believed to be the peak of spawning in Philippine waters. Schaefer and Marr (1948) are of the opinion that along the west coast of Central America *pelamis* spawns at least from January into March. Although there is evidence that it also spawns during this time in Philippine waters, spawning of the greatest intensity occurs during the early summer months.

The data show that in Philippine waters *Katsuwonus pelamis* spawns through the year. The principal spawning period, however, begins in February and reaches its peak in June. Spawning activity then decreases until a period of minimum activity is reached during September and October followed by a slight increase in November and December and another decline during January. A few ripe fish taken during September and December suggests that some spawning may also occur in October and January, although no spawning or spent fish were caught during those months.

NEOTHUNNUS MACROPTERUS (TEMMINCK AND SCHLEGEL)

In tables 7, 8, and 9 and figure 3 are presented the field data for *Neothunnus macropterus* (yellowfin tuna).

Almost one-half (48.5 percent) of the yellowfin tuna caught were immature and too poorly developed to yield information on spawning. The sex of 61 percent of the immature fish could not be determined by the usual field methods.

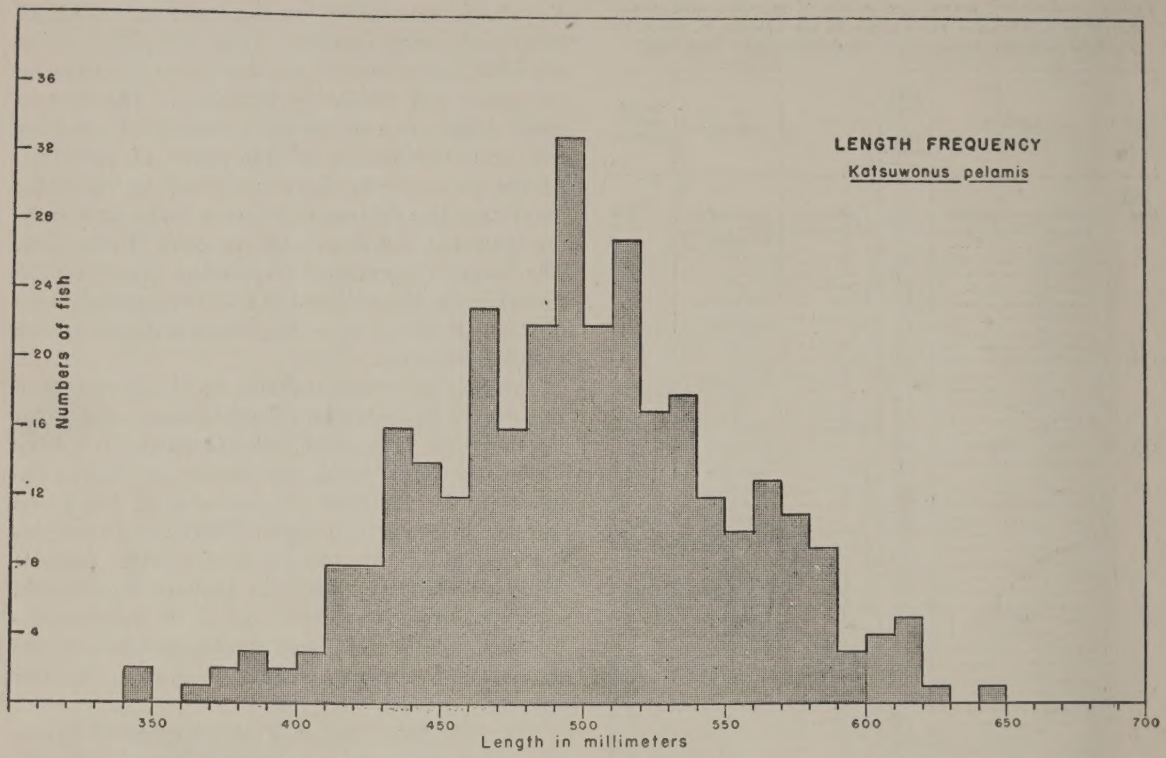

FIGURE 2.—Length-frequency distribution of *Katsuwonus pelamis* taken in Philippine waters from October 1947 through November 1948.

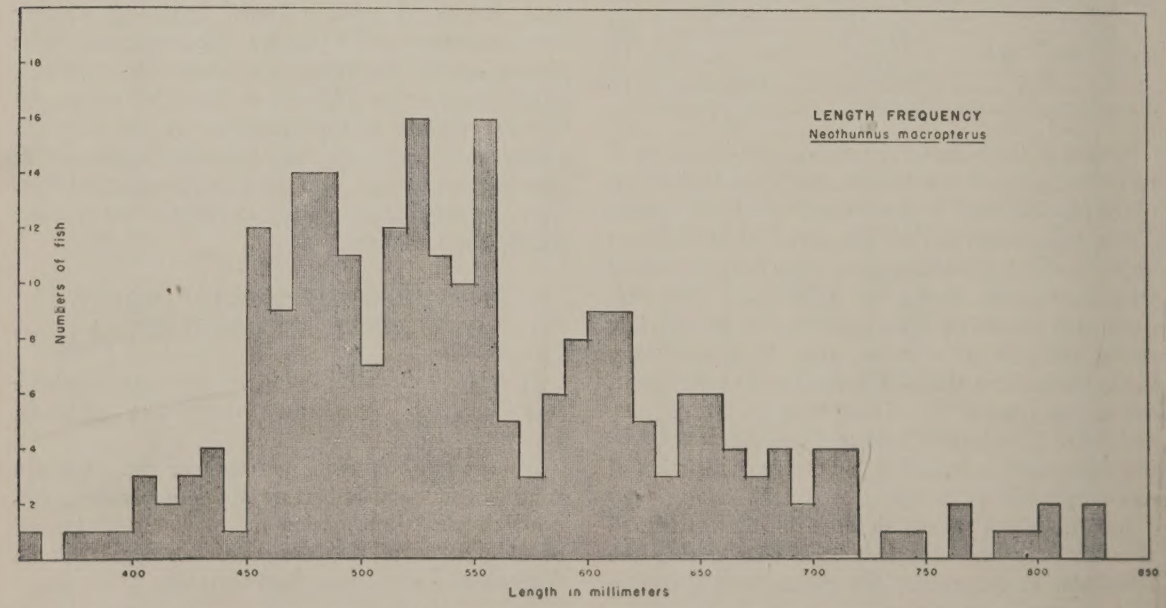

FIGURE 3.—Length-frequency distribution of *Neothunnus macropterus* taken in Philippine waters from October 1947 through November 1948.

TABLE 4.—*Monthly summary of all specimens of troll-caught* Katsuwonus pelamis, *taken by the* Spencer F. Baird, *October 1947–November 1948*

Month	Immature	Ripening	Ripe	Spawning	Spent	Unknown	Total
ALL FISH							
October							
November							
December			6	9		10	25
January		1					1
February		5	2	2		1	10
March		5	7	7	1		20
April	5	1	31	7	1	2	47
May	1	6	33	8	11	1	60
June		6	42	8	33		89
July			25	13	1		39
August		4	11	2	1		18
September			3		1		4
October							
November		2	13	4	1	2	22
Total	6	30	173	60	50	16	335
MALES							
October							
November							
December			3			5	8
January							
February		2	1				3
March		6		2	1		9
April	1		18	1	1		21
May		3	8	5	11		27
June		2	20		27		49
July			13		1		14
August		4	4		1		9
September			3		1		4
October							
November			8		1		9
Total	1	17	78	8	44	5	153
FEMALES							
October							
November							
December			3	9		5	17
January		1					1
February		3	1	2			6
March			7	5			12
April	4	1	13	6		2	26
May	1	3	25	3			32
June		4	22	8	6		40
July			12	13			25
August			7	2			9
September							
October							
November		1	5	4			10
Total	5	13	95	52	6	7	178

TABLE 5.—*Comparison of the length-frequencies of* Katsuwonus pelamis *at several stages of gonad development, taken in Philippine and Marshall Islands waters* [1]

Length in millimeters	Immature				Ripening				Ripe				Spawning				Spent			
	Philippines Male	Marshall Islands Male	Philippines Female	Marshall Islands Female	Philippines Male	Marshall Islands Male	Philippines Female	Marshall Islands Female	Philippines Male	Marshall Islands Male	Philippines Female	Marshall Islands Female	Philippines Male	Marshall Islands Male	Philippines Female	Marshall Islands Female	Philippines Male	Marshall Islands Male	Philippines Female	Marshall Islands Female
340–349											1		1							
350–359																				
360–369	1																			
370–379	1		1																	
380–389	2				1															
390–399	1						1			1										
400–409							1				1								1	1
410–419									6										1	
420–429					1		2		2		1		1						1	
430–439					1	1	6		5	4	2	1	2						1	1
440–449				2	2		1		5	6	4	1	3						2	1
450–459		1		1		4			3	9	3	4	3	1	1				1	1
460–469		1				6	1	1	7	5	8	4	2	1		1		1	2	
470–479						1	1		6	5	2	3	6	1					1	1
480–489						1	1		7	4	7	3	1		1		2		1	1
490–499					1		1		9	3	6	2	6		2		1		2	
500–509					1				7	3	8		3		1				3	
510–519					2				10		7	2	4		2				5	
520–529					1				3		5		5						3	
530–539									4	1	5	1	6						5	
540–549									3	5	4	3	1				1		2	
550–559							2		3	2	1	1	2						3	
560–569					1				7	2	1	1	2						3	
570–579					1				3	4	3	1	2				1		1	
580–589									2	1	5				1				3	
590–599					1					1	1	1							1	
600–609									1	1	2									
610–619										2		1	1				1		2	1
620–629									1	3	1	3								
630–639									1	2		1								
640–649										3		2	1							
650–659										4		6								
660–669		1								6		2								
670–679										3										1
680–689										9										1
690–699										6		1								
700–709										1		1								
710–719										1										
720–729																				
Total	5	3	1	3	13	13	17	1	95	97	78	45	52	3	8	1	6	1	44	9

[1] Length-frequency data on Marshall Islands specimens taken from Marr (1948).

TABLE 6.—*Locality, length, sex, degree of maturity, and gonad weight of* Katsuwonus pelamis *taken in Philippine waters by the* Spencer F. Baird, *October 1947–November 1948*

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1947					
Dec. 11	Sulu Archipelago	540	Male	Unknown	86.0
11	do	505	Female	Ripe	168.2
11	do	485	do	Unknown	90.5
11	do	500	do	Ripe	119.9
11	do	502	Male	Uknown	68.5
11	do	495	do	Spawning	77.2
11	do	512	do	do	51.2
11	do	491	Female	Ripe	126.1
11	do	475	Male	Spawning	59.3
11	do	490	do	do	40.5
11	do	500	do	do	74.5
11	do	490	do	do	71.0
Dec. 12	do	479	do	do	64.7
12	do	497	Female	Unknown	90.0
12	do	510	Male	Ripe	72.0
12	do	532	do	Spawning	74.0
Dec. 13	do	498	do	Unknown	32.0
13	do	462	do	do	18.5
13	do	485	Female	do	39.0
13	do	482	Male	Ripe	40.0
13	do	484	Female	Unknown	57.0
13	do	517	Male	Ripe	54.0
13	do	465	Female	Unknown	48.0
13	do	466	Male	do	12.0
Dec. 15	Zamboanga, Mindanao.	521	do	Spawning	63.0
1948					
Jan. 7	West coast of Panay	510	do	Ripening	65.5
Feb. 23	Moro Gulf, Mindanao.	545	Female	Ripe	110.0
Feb. 25	Celebes Sea	446		Unknown	
Feb. 26	Davao Gulf, Mindanao.	490	Male	Ripe	51.0
26	do	458	do	Spawning	41.4
26	do	473	do	do	70.4
26	do	463	Female	Ripening	76.0
Feb. 27	do	513	Male	do	19.9
Feb. 29	do	429	do	do	33.4
29	do	441	Female	do	56.1
Mar. 3	Celebes Sea	445	do	do	53.5
3	do	438	do	do	37.0
3	do	461	Male	Ripe	39.0
3	do	431	do	do	23.0
Mar. 8	do	425	Female	Ripening	31.2
Mar. 9	do	431	do	do	40.0
9	do	455	Male	Spawning	73.0
9	do	453	do	do	48.5
9	do	437	do	Ripe	32.0
9	do	439	do	Spawning	44.0
9	do	438	do	Ripe	55.0
9	do	435	Female	Ripening	47.0
9	do	452	Male	Ripe	40.0
9	do	461	do	Spawning	63.0
Mar. 13	West coast of Panay	582	Female	do	142.0
13	do	569	Male	Ripe	96.1
13	do	567	do	do	52.2
13	do	546	Female	Spent	49.2
Mar. 19	Verde Island Passage, Luzon.	528	Male	Spawning	52.0
19	do	531	Female	do	69.5
Apr. 6	North Sulu Sea	607	do	Ripe	104.6
6	do	630	Male	do	76.6
6	do	573	do	Spawning	89.5
6	do	592	Female	Ripe	97.0
6	do	575	do	do	76.8
6	do	585	do	do	85.2
Apr. 10	Celebes Sea	495	do	do	48.5
Apr. 11	do	422	do	Spent	15.6
11	do	361	Male	Immature	3.0
11	do	382	do	do	3.9
11	do	372	do	do	1.1
11	do	375	Female	do	7.0
Apr. 13	do	469	do	Ripe	51.6
13	do	500	Male	do	28.9
13	do	460	do	Unknown	20.0
13	do	450	do	do	16.0
13	do	449	do	Spawning	27.9
13	do	448	Female	Ripe	44.5
13	do	390	Male	Immature	3.0
Apr. 15	Sulu Archipelago	445	Female	Ripe	52.5
15	do	426	do	do	36.5
15	do	469	Male	Spawning	45.5
Apr. 16	do	495	do	Ripe	31.0
16	do	520	do	do	58.7
16	do	493	do	Spawning	34.3

TABLE 6.—*Locality, length, sex, degree of maturity, and gonad weight of* Katsuwonus pelamis *taken in Philippine waters by the* Spencer F. Baird, *October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
Apr. 16	Sulu Archipelago	499	Male	Ripe	57.7
16	do	512	do	do	56.5
16	do	515	Female	do	64.5
16	do	505	Male	do	69.1
16	do	494	Female	do	45.1
16	do	504	Male	Spawning	81.5
16	do	509	Female	do	58.2
16	do	520	Male	Ripe	48.1
16	do	490	Female	do	73.0
Apr. 19	Basilan Island, Sulu Archipelago.	488	Male	do	40.8
19	do	510	do	do	42.2
19	do	487	do	Spawning	51.6
19	do	490	do	Ripe	59.1
19	do	520	Female	do	117.2
19	do	483	do	do	86.3
Apr. 20	do	513	Male	do	44.5
Apr. 21	West coast of Zamboanga Peninsula.	485	Female	do	64.0
21	do	564	Male	Ripening	36.6
21	do	542	Female	Ripe	91.5
21	do	514	do	do	104.0
21	do	505	Male	do	48.2
21	do	527	Female	do	83.3
May 4	Luzon Island	560	do	Ripening	177.5
May 6	West Coast of Zamboanga Peninsula.	510	do	Spawning	83
6	do	534	Male	do	50.3
May 9	Basilan Island, Sulu Archipelago.	549	do	Ripe	71.5
9	do	516	do	do	49.5
9	do	491	do	do	42.0
9	do	476	Female	Ripening	38.5
9	do	508	Male	Ripe	32.6
9	do	460	Female	Spent	23.7
9	do	493	do	Ripe	77.1
9	do	535	do	do	37.7
9	do	541	do	do	45.2
9	do	490	do	Spent	38.7
9	do	500	do	Ripe	35.8
9	do	485	do	Spent	34.5
9	do	495	Male	Ripening	27.3
9	do	510	Female	Spent	22.7
9	do	468	Male	Ripe	16.6
9	do	467	do	do	12.7
9	do	471	do	do	17.8
May 10	Sibuguey Bay, Moro Gulf.	498	Female	Spawning	60.9
10	do	445	Male	Ripe	17.5
10	do	441	do	do	17.7
May 11	North Moro Gulf	498	do	do	29.8
11	do	500	Female	Spawning	32.5
11	do	449	Male	Ripening	15.0
11	do	438	Female	do	22.1
11	do	429	Male	Ripe	15.2
11	do	459	Female	Spent	29.5
11	do	449	Male	Ripe	12.4
11	do	447	Female	Spent	22.4
11	do	413	Male	Ripe	29.7
May 12	Off Cotabato Province, Mindanao.	436	Female	Spent	26.9
12	do	422	Male	Ripe	33.2
12	do	402	Female	Spent	12.5
12	do	386	Male	Immature	8
12	do	419	Female	Spent	22.4
12	do	388	Male	Ripening	8.3
12	do	359	(?)	Immature	1.5
12	do	493	Female	Ripe	90.0
12	do	490	do	do	70.0
May 14	Davao Gulf, Mindanao.	576	Male	Spawning	70.2
14	do	568	Female	do	92.5
May 15	do	463	Male	Ripe	37.0
15	do	484	do	do	38.5
15	do	471	Female	Spent	52.9
15	do	460	do	do	58.1
15	do	477	Male	Ripe	58.3
15	do	475	do	do	46.3
15	do	473	do	do	36.2
15	do	455	Female	Spawning	66.5
15	do	440	Male	Ripe	26.4
15	do	489	do	do	43.6
15	do	433	do	do	17.7
May 16	Celebes Sea	436	do	do	31.2
16	do	412	do	do	18.2

TABLE 6.—*Locality, length, sex, degree of maturity, and gonad weight of* Katsuwonus pelamis *taken in Philippine waters by the* Spencer F. Baird, *October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
May 16	Celebes Sea	422	Male	Spawning	5.0
May 20	West coast of Zamboanga Peninsula.	539	Female	Ripe	94.6
20	do	547	Male	do	83.9
May 22	North coast of Mindoro.	584	Female	do	122.1
June 14	Batangas, Luzon	505	do	do	69.2
June 15	East and south coast of Mindoro.	456	Male	do	30.2
15	do	481	Female	do	40.5
15	do	530	Male	Spawning	55.4
15	do	525	do	do	53.2
June 16	Southwest of Panay	575	Female	Ripe	59.8
16	do	535	do	do	63.9
16	do	532	Male	Spawning	31.0
16	do	525	Female	Spent	56.7
16	do	530	Male	Spawning	32.0
16	do	550	do	do	54.1
16	do	548	Female	Spent	89.0
16	do	597	do	do	208.5
June 18	Zamboanga Peninsula, Mindanao.	533	do	do	61.2
June 19	East Sulu Sea	529	Male	Spawning	50.0
19	do	503	do	Ripening	32.0
June 21	Dumarin Island, Palawan.	509	do	Ripe	19.0
21	do	505	do	Spent	22.5
21	do	485	do	do	32.0
21	do	522	Female	do	66.8
21	do	499	do	do	53.4
21	do	537	do	do	56.5
21	do	513	do	do	82.2
21	do	520	do	do	94.6
21	do	493	Male	Spawning	23.6
21	do	515	Female	Spent	48.4
21	do	553	do	do	56.5
21	do	483	Male	do	26.5
21	do	516	do	Spawning	31.0
21	do	547	do	Spent	43.5
21	do	538	Female	do	63.6
21	do	508	do	do	51.0
21	do	615	do	do	83.9
21	do	518	do	do	52.3
21	do	538	do	do	25.8
21	do	486	do	do	36.4
21	do	580	do	do	58.6
June 22	Tubbataha Reefs, Sulu Sea.	614	do	do	82.3
22	do	595	Male	Ripening	76.7
22	do	615	do	Spent	82.6
22	do	539	do	Ripe	28.0
22	do	560	Female	Spent	49.0
22	do	558	do	Ripening	8.2
22	do	555	Male	Ripe	33.2
22	do	553	Female	Spent	43.0
22	do	555	Male	Ripe	44.6
22	do	583	Female	do	103.8
22	do	574	do	Spent	50.5
22	do	551	do	do	46.8
22	do	570	Male	Ripe	73.0
22	do	621	do	do	58.5
22	do	605	Female	do	44.1
22	do	579	do	do	70.0
June 23	Puerto Princesa, Palawan.	535	do	Ripe	54.1
23	do	526	Male	Ripening	30.0
23	do	509	Female	Ripe	47.1
23	do	525	do	do	54.5
23	do	561	Male	do	35.0
23	do	564	do	do	36.0
23	do	545	do	do	60.6
23	do	565	do	do	38.2
23	do	553	Female	Ripening	5.1
23	do	546	do	Ripe	65.0
23	do	566	do	do	61.0
23	do	561	Male	do	33.5
23	do	530	do	do	54.0
23	do	576	do	Ripening	30.5
23	do	533	Female	Spent	60.0
23	do	535	do	Ripe	74.4
23	do	515	Male	do	43.0
23	do	507	Female	do	58.0

TABLE 6.—*Locality, length, sex, degree of maturity, and gonad weight of* Katsuwonus pelamis *taken in Philippine waters by the* Spencer F. Baird, *October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
June 23	Puerto Princesa, Palawan.	516	Female	Ripe	51.0
23	do	519	Male	do	25.0
23	do	530	do	do	36.2
23	do	531	do	do	32.8
23	do	505	do	do	36.0
June 24	West Sulu Sea	584	Female	Spent	55.8
24	do	510	Male	Ripe	41.2
24	do	578	do	Spent	27.3
24	do	580	Female	do	57.2
June 25	East Sulu Sea	525	Male	Ripe	50.0
June 27	North Sulu Sea	563	Female	Spent	58.5
27	do	540	do	Ripe	40.5
June 29	Busuanga Islands, China Sea.	488	do	do	51.7
29	do	488	do	do	45.0
29	do	458	do	do	66.5
29	do	468	Male	do	15.6
29	do	466	Female	do	42.0
29	do	492	Male	do	55.0
July 10	South Sulu Sea	504	Female	do	45.0
10	do	498	Male	do	35.1
10	do	508	Female	do	37.4
10	do	510	Male	Spawning	46.8
July 11	do	551	do	Ripe	81.5
11	do	508	do	do	70.0
July 14	Balabac Island, Sulu Sea.	508	do	do	41.3
14	do	458	Female	do	63.5
14	do	457	do	do	50.0
14	do	345	Male	Spawning	31.0
14	do	340	Female	Ripe	33.5
July 17	West coast of Zamboanga Peninsula.	565	Male	Spawning	34.5
17	do	588	Female	Ripe	98.5
July 18	West coast of Panay	528	do	do	84.0
18	do	516	Male	do	25.0
July 27	North Sulu Sea	565	do	do	36.3
27	do	554	do	Spawning	43.6
27	do	535	do	do	41.0
27	do	516	Female	Ripe	51.2
27	do	540	Male	Spawning	37.0
27	do	564	do	do	67.2
27	do	518	do	do	30.5
27	do	643	do	do	100.0
27	do	627	Female	Ripe	150.5
27	do	615	Male	Spawning	94.0
July 29	Zamboanga, Mindanao.	481	do	Ripe	21.0
29	do	472	do	do	29.5
29	do	476	do	Spawning	32.5
29	do	500	Female	Spent	39.0
29	do	478	Male	Ripe	32.3
29	do	478	do	Spawning	39.5
29	do	448	do	Ripe	29.0
29	do	440	Female	do	29.0
29	do	436	Male	Spawning	18.0
29	do	448	Female	Ripe	27.0
July 30	Sulu Archipelago	453	Male	do	33.2
30	do	416	do	do	14.7
30	do	452	Female	do	35.6
30	do	405	do	do	67.7
Aug. 1	Northeast coast of Borneo.	420	do	Ripening	14.2
Aug. 2	Southwest Celebes Sea.	431	do	do	25.0
2	do	401	do	do	11.8
2	do	396	do	do	14.0
Aug. 6	do	465	Male	Ripe	48.0
6	do	440	do	Spawning	28.5
6	do	442	Female	Spent	34.5
6	do	440	Male	Spawning	28.0
Aug. 10	Sibuguey Bay, Moro Gulf.	519	do	Ripe	28.0
10	do	486	Female	do	37.0
10	do	521	do	do	66.0
10	do	488	do	do	34.0
10	do	481	Male	do	29.0
Aug. 11	Northeast Sulu Sea	580	Female	do	87.0
11	do	608	Male	do	70.0
11	do	580	do	do	67.0
11	do	577	do	do	65.0
Aug. 31	South Sibuyan Sea	584	do	do	60.0

TABLE 6.—*Locality, length, sex, degree of maturity, and gonad weight of* Katsuwonus pelamis *taken in Philippine waters by the* Spencer F. Baird, *October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
Sept. 4	North Moro Gulf	456	Female	Spent	55.5
Sept. 13	Celebes Sea	460	do	Ripe	43.0
13	do	466	do	do	82.0
13	do	465	do	do	49.0
Nov. 4	North Palawan	498	do	Spent	54.0
4	do	475	Male	Spawning	24.0
4	do	495	Female	Ripe	40.0
Nov. 6	Northeast Palawan	510	do	do	50.0
6	do	498	Male	Spawning	54.0
Nov. 7	East coast of Palawan	525	do	do	53.0
Nov. 10	do	430	Female	Ripe	20.0
10	do	410	Male	do	10.0
10	do	417	do	do	6.0
10	do	465	Female	do	30.0
10	do	415	Male	do	4.0
10	do	430	Female	do	20.0
Nov. 13	South Sulu Sea	515			
Nov. 15	do	433	Male	Ripening	4.0
15	do	464	do	Ripe	8.0
Nov. 20	Northeast Sulu Sea	490			18.0
20	do	470	Female	Ripe	14.0
20	do	480	Male	do	10.0
Nov. 21	North Sulu Sea	510	Female	do	40.0
Nov. 22	do	495	Male	Spawning	30.0
22	do	488	Female	Ripe	40.0
Nov. 23	West coast of Mindoro.	495	do	Ripening	40.0

The most of the other individuals of this species in the collection were considered to be ripening. Ripening individuals were found throughout the year but most abundantly from April through August. Only a few ripe specimens were taken in the course of the operations and no spawning or spent fish were captured. Although the sample is not sufficiently adequate to form the basis for conclusions regarding spawning, it appears that as scattered specimens of ripe fish are found over a long period of time the spawning period is an extended one. On the basis of the present data the spawning period seems to be most intense during May, June, July, and August.

TABLE 7.—*Monthly summary of all specimens of troll-caught* Neothunnus macropterus, *taken by the* Spencer F. Baird, *October 1947–November 1948*

Month	Immature	Ripening	Ripe	Spawning	Spent	Unknown	Total
ALL FISH							
October							
November							
December	6	25	1			2	34
January	3		1			1	5
February		2					2
March		2	1			9	12
April	2	11				11	24
May	24	4	1			12	41
June	4	37	6			1	48
July	2	6	1			14	23
August	4	16	2			13	35
September		2	2			8	12
October							
November		3					3
Total	45	108	15			71	239
MALES							
October							
November							
December	3	14	1				18
January	1		1				2
February							
March			1				1
April	2	6					8
May	13	2	1				16
June	3	20	4				27
July	1	3	1				5
August	2	8	2				12
September		1	2				3
October							
November							
Total	25	54	13				92
FEMALES							
October							
November							
December	3	11					14
January	2						2
February		2					2
March		2					2
April		5					5
May	11	2					13
June	1	17	2				20
July	1	3					4
August	2	8					10
September		1					1
October							
November		3					3
Total	20	54	2				76

TABLE 8.—*Length-frequency at several stages of gonad development of* Neothunnus macropterus *from the Philippines and the northern Marshall Islands* [1]

Length in millimeters	Immature					Ripening				Ripe				Spent			
	Philippines	Philippines	Marshall Islands	Philippines	Marshall Islands	Philippines	Marshall Islands	Philippines	Marshall Islands	Philippines	Marshall Islands	Philippines	Marshall Islands	Philippines	Marshall Islands	Philippines	Marshall Islands
	Sex ?	Male	Male	Female	Female	Male	Male	Female	Female	Male	Male	Female	Female	Male	Male	Female	Female
340–359	1																
360–379	1																
380–399	2																
400–419	5												None		None		
420–439	7													None		None	
440–459	13																
460–479	18	1		2													
480–499	10	9		6													
500–519	6	5	2	8		1		1									

See footnote at end of table.

TABLE 8.—*Length-frequency at several stages of gonad development of* Neothunnus macropterus *from the Philippines and the northern Marshall Islands* [1]—Continued

Length in millimeters	Immature					Ripening				Ripe				Spent			
	Philippines Sex ?	Philippines Male	Marshall Islands Male	Philippines Female	Marshall Islands Female	Philippines Male	Marshall Islands Male	Philippines Female	Marshall Islands Female	Philippines Male	Marshall Islands Male	Philippines Female	Marshall Islands Female	Philippines Male	Marshall Islands Male	Philippines Female	Marshall Islands Female
520–539	6	6	11	1	1	7	1	4	------	1	1	------	------	------	------	------	------
540–559	------	2	16	1	3	10	1	10	------	3	------	------	------	------	------	------	------
560–579	------	1	9	------	1	4	------	4	------	------	------	------	------	------	------	------	------
580–599	------	------	3	1	2	6	1	4	------	1	------	------	------	------	------	------	------
600–619	2	------	7	------	------	5	------	9	------	3	------	------	------	------	------	------	------
620–639	------	------	6	------	3	5	------	4	------	------	------	------	------	------	------	------	1
640–659	------	1	1	1	5	6	------	4	------	------	5	------	------	------	------	------	------
660–679	------	------	5	------	2	3	2	3	1	2	2	------	------	------	------	------	------
680–699	------	------	4	------	4	2	------	4	------	------	------	------	------	------	------	------	------
700–719	------	------	3	------	------	4	------	2	2	1	------	2	------	------	------	------	------
720–739	------	------	2	------	1	------	1	------	------	1	------	------	------	------	------	------	------
740–759	------	------	2	------	1	------	------	1	------	------	------	------	------	------	------	------	------
760–779	------	------	2	------	------	1	1	1	------	------	------	------	------	------	------	------	------
780–799	------	------	------	------	2	------	1	2	------	------	------	------	------	------	------	------	------
800–819	------	------	1	------	------	1	------	1	------	------	------	------	------	------	------	------	------
820–839	------	------	------	------	------	1	------	------	------	1	------	------	------	------	------	------	3
840–859	------	------	2	------	------	------	------	------	1	------	1	------	------	------	------	------	------
860–879	------	------	------	------	2	------	------	------	------	------	------	------	------	------	------	------	------
880–899	------	------	------	------	------	------	------	------	------	------	1	------	------	------	------	------	1
900–919	------	------	------	------	1	------	------	------	------	------	------	------	------	------	------	------	------
920–939	------	------	------	------	------	------	2	------	1	------	------	------	------	------	------	------	1
940–959	------	------	------	------	------	------	1	------	1	------	------	------	------	------	------	------	------
960–979	------	------	------	------	------	------	------	------	1	------	------	------	------	------	------	------	------
980–999	------	------	------	------	------	------	------	------	1	------	------	------	------	------	------	------	------
1,000–1,019	------	------	------	------	------	------	1	------	------	------	1	------	------	------	------	------	------
1,020–1,039	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1,040–1,059	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	1
1,060–1,079	------	------	------	------	------	------	------	------	1	------	------	------	------	------	------	------	------
1,080–1,099	------	------	------	------	------	------	------	------	------	------	1	------	------	------	------	------	------
1,100–1,119	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1,120–1,139	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1,140–1,159	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1,160–1,179	------	------	------	------	------	------	------	------	------	------	1	------	------	------	------	------	------
1,180–1,199	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
1,200–1,219	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------	------
Total	71	25	76	20	28	54	12	54	9	13	13	2	0	0	0	0	7

[1] Length-frequency data of Marshall Islands specimens taken from Marr (1948).

TABLE 9.—*Locality, length, sex, degree of maturity, and gonad weight of* Neothunnus macropterus *taken in Philippine waters by the* Spencer F. Baird, *October 1947–November 1948*

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1947					
Dec. 11	Sibutu Passage, Sulu Archipelago.	673	Female	Ripening	131.4
11	do	575	Male	do	21.9
11	do	520	do	do	12.0
11	do	560	do	do	15.6
11	do	608	do	Ripe	85.9
11	do	601	do	Ripening	33.0
11	do	601	do	do	40.0
11	do	512	Female	Immature	8.0
11	do	700	Male	Ripening	94.0
11	do	645	do	do	70.0
11	do	595	do	do	63.3
11	do	610	Female	do	99.2
Dec. 12	do	568	do	do	52.0
12	do	574	Male	do	32.5
12	do	523	do	Immature	3.5
12	do	554	Female	Ripening	26.5
12	do	575	do	do	22.2
12	do	612	do	do	74.8
12	do	555	do	do	14.4
12	do	547	do	do	48.6
12	do	468	do	do	58.5
12	do	546	Male	do	31.5
12	do	621	do	do	66.5
12	do	480	Unknown	Immature	2.3
12	do	590	Male	Ripening	38.2
12	do	626	do	do	35.7

[1] Gonad weight less than 1 gram.

TABLE 9.—*Locality, length, sex, degree of maturity, and gonad weight of* Neothunnus macropterus *taken in Philippine waters by the* Spencer F. Baird, *October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1947					
Dec. 12	Sibutu Passage, Sulu Archipelago.	553	Male	Ripening	46.1
12	do	527	Female	Immature	4.6
12	do	517	do	do	8.0
12	do	520	Unknown	do	2.4
12	do	526	Male	do	8.0
12	do	510	do	do	5.5
Dec. 16	Basilan Island, Sulu Archipelago.	596	Female	Ripening	54.0
16	do	602	do	do	12.0
1948					
Jan. 12	Sulu Archipelago	583	Unknown	Immature	3.0
12	do	612	Male	Ripe	13.5
12	do	587	Female	Immature	6.8
12	do	546	do	do	7.8
12	do	545	Male	do	4.2
Feb. 19	Port Santa Maria, Zamboanga Peninsula.	797	Female	Ripening	72.1
19	do	785	do	do	58.3
Mar. 4	Celebes Sea	604	do	do	106.0
4	do	587	do	do	76.2
4	do	525	Male	Ripe	38.0
Mar. 8	do	470	Unknown	Immature	[1]
8	do	455	do	do	
8	do	352	do	do	

TABLE 9.—*Locality, length, sex, degree of maturity, and gonad weight of* Neothunnus macropterus *taken in Philippine waters by the* Spencer F. Baird, *October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
Mar. 14	Verde Island Passage, Luzon.	480	Unknown	Immature	
14	do	453	do	do	
14	do	463	do	do	
14	do	478	do	do	
14	do	482	do	do	
14	do	473	do	do	
Apr. 11	Celebes Sea	454	do	do	
11	do	450	do	do	
11	do	449	do	do	
Apr. 12	do	493	Male	do	2.0
12	do	426	Unknown	do	1.9
12	do	433	do	do	2.6
Apr. 13	do	614	Female	Ripening	74.4
13	do	464	Unknown	Immature	1.5
13	do	556	Female	Ripening	61.5
13	do	593	Male	do	31.2
13	do	558	do	do	48.3
13	do	418	Unknown	Immature	1.0
Apr. 14	do	492	do	do	2.2
14	do	470	do	do	1.4
14	do	472	do	do	2.0
14	do	477	Male	do	3.8
Apr. 17	Sulu Archipelago	631	do	Ripening	14.1
17	do	630	Female	do	19.1
17	do	530	Male	do	8.5
Apr. 18	do	600	do	do	7.5
Apr. 19	Basilan Island	596	Female	do	12.4
19	do	665	do	do	17.3
Apr. 21	West coast of Zamboanga Peninsula.	501	Unknown	Immature	2.3
21	do	537	Male	do	8.1
May 6	do	526	Unknown	do	2.5
6	do	521	Male	do	3.5
May 9	East coast Zamboanga.	485	do	do	2.1
9	do	478	Female	do	2.1
9	do	492	Unknown	do	2.0
9	do	517	Male	do	2.1
9	do	517	Female	do	2.3
9	do	769	do	Ripening	103.4
9	do	665	Male	do	42.9
9	do	608	Female	do	48.3
May 10	North Moro Gulf	531	Male	Immature	3.5
10	do	672	do	Ripe	63.8
May 12	East Moro Gulf	483	Female	Immature	2.4
12	do	514	do	do	2.9
12	do	488	Male	do	2.3
12	do	516	do	Ripening	12.0
12	do	418	Unknown	Immature	1.3
12	do	496	Male	do	2.0
12	do	484	do	do	2.0
12	do	507	Female	do	2.8
12	do	491	do	do	4.5
12	do	497	do	do	1.6
12	do	461	Unknown	do	2.3
12	do	485	Male	do	2.4
12	do	409	Unknown	do	1.9
12	do	472	Female	do	2.2
12	do	497	do	do	2.0
12	do	487	Male	do	2.2
12	do	484	Unknown	do	1.4
12	do	503	Female	do	5.0
12	do	512	Unknown	do	1.9
12	do	593	Male	Ripening	20.9
12	do	505	Unknown	Immature	2.5
12	do	504	Male	do	6.0
12	do	475	Unknown	do	2.3
12	do	528	do	do	2.0
12	do	492	Female	do	5.5
12	do	479	Unknown	do	2.2
12	do	488	Male	do	1.6
May 15	Davao Gulf, Mindanao.	491	do	do	1.8
May 22	Mindanao Sea	526	Unknown	do	1.0
22	do	533	Male	do	4.2
June 17	East Sulu Sea	513	do	do	2.5
17	do	524	do	Ripening	8.2
June 18	West coast of Zamboanga Peninsula.	520	do	Immature	2.5
18	do	732	do	Ripe	65.0
18	do	612	do	Ripening	16.4
June 22	Tubbataha Reefs, Sulu Sea.	800	Female	do	47.0
22	do	745	do	do	77.2

TABLE 9.—*Locality, length, sex, degree of maturity, and gonad weight of* Neothunnus macropterus *taken in Philippine waters by the* Spencer F. Baird, *October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
June 23	East coast of Palawan	828	Male	Ripe	52.3
23	do	674	do	Ripening	30.0
23	do	683	Female	do	25.3
23	do	660	do	do	25.0
23	do	618	do	do	10.5
23	do	650	Male	do	43.9
23	do	662	do	do	11.6
23	do	640	do	do	10.0
23	do	657	do	do	7.5
23	do	651	Female	do	32.5
23	do	700	do	Ripe	85.7
23	do	668	Male	do	21.5
23	do	710	Female	do	54.6
23	do	622	do	Ripening	22.6
23	do	656	do	do	86.2
23	do	715	Male	do	32.1
23	do	708	do	Ripe	55.0
23	do	697	do	Ripening	17.0
23	do	656	do	do	14.0
23	do	696	Female	do	37.2
23	do	613	do	do	11.5
23	do	630	do	do	18.0
23	do	641	do	do	21.0
23	do	597	Male	do	11.0
23	do	627	do	do	9.0
23	do	646	Female	do	20.0
23	do	604	Male	Ripening	65.0
23	do	652	do	Immature	4.0
23	do	700	do	Ripening	17.0
23	do	643	do	do	18.0
23	do	640	Female	Immature	3.0
23	do	596	Unknown	do	
June 24	West Sulu Sea	716	Female	Ripening	32.5
24	do	682	do	do	25.5
24	do	711	Male	do	10.5
24	do	800	do	do	60.0
24	do	828	do	do	43.0
24	do	769	do	do	40.0
24	do	618	Female	do	27.4
June 27	Cuyo Islands, Sulu Sea.	683	do	do	44.0
27	do	689	Male	do	60.5
July 12	Southwest Sulu Sea	531	Unknown	Immature	
July 16	South Sulu Sea	462	do	do	
16	do	457	do	do	
July 17	West coast of Zamboanga Peninsula.	550	Male	Ripening	5.1
17	do	518	Female	Immature	2.5
17	do	554	Male	Ripening	6.2
17	do	520	do	Immature	3.6
17	do	522	Female	Ripening	9.0
17	do	455	Unknown	Immature	
July 27	Northeast Sulu Sea	385	do	do	
27	do	422	do	do	
July 29	Basilan Island, Sulu Archipelago.	531	Female	Ripening	12.0
29	do	481	Unknown	Immature	
29	do	437	do	do	
29	do	397	do	do	
29	do	406	do	do	
29	do	585	Male	Ripening	14.5
29	do	505	Unknown	Immature	
July 30	Sulu Archipelago	475	do	do	
30	do	532	Female	Ripening	42.2
30	do	617	Male	Ripe	42.5
30	do	451	Unknown	Immature	
30	do	458	do	do	
Aug. 1	Northeast coast of Borneo, Celebes Sea.	430	do	do	
1	do	459	do	do	
Aug. 3	West Celebes Sea	438	do	do	
Aug. 4	do	461	do	do	
4	do	458	do	do	
4	do	428	do	do	
Aug. 6	do	546	Female	Ripening	39.3
6	do	540	do	do	29.1
6	do	535	Male	do	26.2
Aug. 7	Basilan Island, Mindanao.	585	do	Ripe	40.0
7	do	516	Female	Ripening	7.0
7	do	563	Male	do	8.5
7	do	536	Female	do	7.0
7	do	527	Male	do	7.5
7	do	537	do	do	5.0

TABLE 9.—*Locality, length, sex, degree of maturity, and gonad weight of* Neothunnus macropterus *taken in Philippine waters by the* Spencer F. Baird, *October 1947–November 1948*—Continued

Date	Locality	Fork length in millimeters	Sex	Degree of maturity	Gonad weight in grams
1948					
Aug. 7	Basilan Island, Mindanao.	487	Female	Immature	4.5
7	do	476	Unknown	do	
7	do	518	Female	do	4.0
7	do	504	Male	do	3.0
7	do	454	Unknown	do	
7	do	502	do	do	
7	do	476	do	do	
7	do	464	do	do	
Aug. 10	Zamboanga, Mindanao.	472	do	do	
10	do	567	Female	Ripening	10.5
10	do	544	Male	Immature	4.5
10	do	550	do	Ripening	6.0
10	do	545	do	do	6.5
10	do	554	do	do	7.0
10	do	551	do	do	29.0
10	do	555	Female	do	10.5
10	do	573	do	do	13.0
10	do	522	Unknown	Immature	
10	do	554	Female	Ripening	7.0
10	do	548	Male	Ripe	26.0
Sept. 3	West coast of Zamboanga Peninsula	565	do	Ripening	7.0
Sept. 4	North Moro Gulf	454	Unknown	Immature	
4	do	464	do	do	
4	do	481	do	do	
4	do	497	do	do	
4	do	480	do	do	
4	do	460	do	do	
4	do	371	do	do	
Sept. 6	Sarangani Island, Sulu Archipelago.	543	Female	Ripening	17.0
6	do	555	Male	Ripe	18.5
6	do	552	do	do	15.5
6	do	406	Unknown	Immature	
Nov. 16	South Sulu Sea	550	Female	Ripening	14.0
16	do	620	do	do	16.0
16	do	580	do	do	11.0

SUMMARY

The data for these preliminary observations on the spawning of tuna in Philippine waters were collected aboard the Philippine Fishery Program's research vessel *Spencer F. Baird* from October 1947 through November 1948. Three species of tuna, *Neothunnus macropterus*, *Katsuwonus pelamis*, and *Euthynnus yaito*, were collected in numbers sufficient to make several tentative observations relative to their spawning. The gross field method used in determining the degree of sexual maturity, although satisfactory for preliminary exploratory studies, needs considerable refinement before it can be used in a comprehensive study of the life histories of the several species.

Euthynnus yaito, in all stages of sexual maturity, was noted throughout the period, and was the most abundant species taken during these studies. The sample was not sufficiently adequate to determine accurately if spawning remains fairly constant throughout the year or if a peak or several peaks of intensive spawning occur followed by periods in which only a few scattered individuals spawn. On the basis of the available data the former seems likely.

The second most abundant species taken was *Katsuwonus pelamis*. Both males and females in all degrees of sexual maturity were taken throughout the year. The data indicate that spawning of greater intensity occurs during April, May, June, and July than the rest of the year.

The collection of *Neothunnus macropterus* furnished little data on the spawning habits of this species as almost one-half of the fish caught were immature and most of the others taken were in the early stages of ripening. Only a few individuals were taken that were classified as ripe and no spawning or spent fish were caught. Scattered specimens of ripe males were taken at random intervals throughout the year, and two ripe females were taken in June. Data based upon ripening fish and a few ripe individuals indicate that spawning apparently extends over a considerable period but is most intense during May, June, July, and August.

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